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ABSTRACT

While research provides many examples of preschoolers' overconfidence and overestimation of performance, there has thus far been relatively little investigation of the source of these qualities. Recent research suggests that even 2- and 3-year-old children possess a "theory of mind," and know that they and other people think, know, learn, remember, and forget things. It no longer seems plausible to suggest that preschoolers are entirely unaware of their own cognitive activities or limitations. An alternative theory of overconfidence suggests that preschoolers overestimate the efficacy of their emerging strategies, not their own cognitive capacities. This possibility was empirically tested. A total of 14 preschool children and 10 second grade students watched as a target object was hidden in one of 144 identical locations, and then predicted whether they would relocate the object after a distractor task. Results showed that younger children were more likely than older children to overestimate their performance. Both older and younger children used strategies to help themselves remember the target location, but younger children were less likely to use effective strategies. Results supported the alternative theory of overconfidence. (RH)

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Preschoolers' memory development: From ineffective to effective strategies

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Running head: Strategies

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Abstract

Previous research has shown that preschoolers tend to overestimate their own performance on several types of memory tasks. However, relatively little is known about the source of young children's overconfidence in their own memories. The goal of this study was to learn whether preschoolers' overconfidence might be associated with the use of ineffective strategies. Preschoolers and second graders observed as a target object was hidden in one of 144 identical locations, and then predicted whether they would relocate the object after a distractor task. The results showed that younger children were more likely to overestimate their performance. In addition, both older and younger children use strategies to help themselves remember the target location; however, the younger children were less likely to use effective strategies. The results suggest that preschoolers may be overconfident in the efficacy of their strategies, rather than in their own cognitive abilities.

Preschoolers' memory development: From ineffective to effective strategies

Research on the development of metacognitive knowledge has shown that preschool children lack important knowledge about their own memory and learning processes. In particular, young children often fail to use strategies to enhance their own ability to learn and remember new information, even when they are prompted to use such strategies by an adult (Flavell, 1970). Young children's failure to use effective strategies has sometimes been attributed to a lack of metacognitive knowledge about their own cognitive limitations. For example, if children do not know that they are likely to forget under particular task conditions, they would not necessarily understand that they should take action to help themselves remember. Flavell, Friedrichs, and Hoyt (1970), and Yussen and Levy (1975) found that preschoolers and kindergartners consistently overestimated the size of their memory spans. Although young children are aware of their own past performance and have the appropriate estimation skills, they seem to ignore this information when estimating how well they will do in the future on a memory task (Markman, 1973; Pressley, Levin, Ghatala, & Ahmad, M., 1987; Schneider, 1988). Their overconfidence in their own memory prowess has been assumed to contribute to children's failure to use or retain strategies that would help them in the task.

While there are many examples of preschoolers' overconfidence and overestimation of performance, there has thus far been relatively little consideration about what the *source* of this overconfidence might be. Little information is available about the assumptions and behaviors from which young children derive their estimates of their own memory performance, or about how these estimates are eventually transformed into more accurate assessments of their own cognitive abilities, and presumably, more efficient self-regulation of learning and memory. Recent research suggests that even 2-3 year old children possess a "theory of mind," and know that they and other people

think, know, learn, remember and forget things (Astington, Harris & Olson, 1988). It no longer seems plausible to suggest that preschoolers simply are entirely unaware of their own cognitive activities or limitations. An alternative view is that preschoolers are overconfident of their performance in memory tasks because they *are* making deliberate attempts to improve their performance, although they are more likely to use ineffective or partially-effective strategies than older children. This view would suggest that preschoolers overestimate the efficacy of their emerging strategies, not their own cognitive capacities.

The possibility that preschoolers relied on ineffective strategies was suggested by previous research on children's failure to use reminders in prospective memory tasks (Beal, 1985; Ritter, 1978). In one such task, developed by Ritter (1978), a target object is hidden in one of a set of identical containers. The containers are then moved to new locations while the child's eyes are closed. The child must then try to relocate the baited container. An effective strategy for this task is to mark the baited container before the containers are moved. Ritter (1978) and Beal (1985) found that preschoolers in this task generally failed to use a marker to help themselves relocate the target, and that they tended to overestimate the informativeness of markers that were incorrectly placed. In addition, children often appear to be overly confident that they will relocate the hidden object, even after they have failed to do so on several trials.

In a pilot study with 21 preschoolers using the Ritter task, we noticed some behaviors by the children that appeared to be strategic, although the behaviors were actually ineffective in the task. While six of the children (28%) made no attempt to use a marker even when they were prompted by the experimenter, 14 additional children (67%) did attempt to use it, although they did so ineffectively. (One child spontaneously used the marker correctly without assistance or prompting.) The children's ineffective strategies

fell into two types: attempts to help themselves prepare for retrieval during the storage phase, and attempts to help themselves relocate the object after the cups had been moved. The dominant "preparation" strategy, used by five children, was to place the marker *next to* the baited cup, rather than on top of it. This action does create the necessary association between the target and the marker, but would not be effective in the Ritter task because the target is moved before the retrieval step. Another preparation strategy, used by four additional children, was to try to attach the paper clip permanently to the baited cup by pushing it through the cup wall or binding it with a rubber band. (The experimenter explained that the child could not damage the containers in this game, and asked the child to think of another way that the marker could be used.) Strategies that were more oriented towards retrieval included using the paper clip to tap on the top of the cups in order to hear the target rattle inside (two children) and placing the marker next to an *unbaited* cup before the cups were moved (five children.) While it is impossible to be entirely sure what this latter behavior meant, comments from several children suggested that they were guessing that the baited container might be moved to the marked location, and that the marker would help them know where to look during the retrieval phase of the trial.

These behaviors suggested that the children recognized that they might not automatically relocate the hidden object, and that the marker could help them in the task. However, they did not know precisely how the marker should be used, given the many constraints of the task. Thus, they appeared to be strategic but lacking in knowledge about the particular strategy that would be effective in the novel task. In addition, these observations suggested the possibility that preschoolers might be overconfident because they were making efforts to improve their performance, even if those efforts were not actually productive. However, the children in this pilot study were not asked to estimate their own performance. Thus, the goal of the present study was to test whether overconfidence in their own memory by preschoolers might be

associated with the use of ineffective strategies. The retrieval task developed by Heisel and Ritter (1981) was used because it involves many more hiding locations and reduces the likelihood that the child will relocate the object by chance, without the use of a marker or other strategy.

Method

Subjects. Fourteen preschoolers (M = 5.2 years) and ten second graders (M = 7.2 years) participated in the study. Children were from a middle class rural community surrounding a small college. All the children passed the check trials (described below.)

Materials. A 24 x 24 inch board that held 144 small lidded black film canisters, arranged in a 12 x 12 matrix, was used in the task. The containers were nailed to the board, which stood upright at a 75% angle. Cartoon stickers that fit completely inside the canisters were used as target objects. Other materials included crayons, coloring books, a grease pencil and a pipe cleaner ring that could be slipped over a single canister.

Procedure. Each child was tested individually in a session that lasted 30-40 minutes.

Pretraining. The experimenter began the session by showing the child the board and demonstrating that a sticker could be hidden inside one of the containers while the child watched. After a 30 second distractor task (described below) the child was asked to relocate the sticker by putting the pipe cleaner ring on the container where he or she thought the sticker was hidden. After several practice trials, the child was asked to hide the sticker from the experimenter. The experimenter then deliberately failed to relocate the target correctly, to reassure the child that it was difficult even for adults to remember exactly where the object had been stored after a delay.

Test trials. After pretraining, there were eight test trials. On each trial, the experimenter stored the target in a container while the child watched. (The sequence of storage locations had previously been determined by drawing locations at random, excluding the four corner locations which were considered easy to remember.) After storing the

object, the experimenter asked the child the *prediction* question: "Do you think you will remember/find where it was hidden, or do you think maybe you won't remember/find it for sure?" The term "remember" was used for half the subjects, with "find" used for the remaining subjects. In addition, the order of mention of "will remember/find" vs. "won't remember/find" was varied across trials for each child.

After the object was stored, the child participated in a distractor task. The preschoolers turned to a nearby table and colored for 30 seconds in a coloring book, facing away from the board. The second graders were asked to say each letter of the alphabet, followed by the name of an object beginning with that letter, for 30 seconds. After the distractor period, the child returned to the board and placed the pipe cleaner ring over the container where he or she thought the sticker had been hidden.

On the test trials, the experimenter recorded the child's prediction as to whether or not he or she would relocate the object, and where the child searched for the object after the distractor task. The experimenter also recorded any strategies that the child appeared to be using to prepare for retrieval, including counting the rows and/or columns; pointing, touching or staring intently at the baited container; or mentioning a potential landmark on the board, such as a nearby container that appeared to be slightly tilted or dusty.

Check trials. In addition to the eight test trials, there were three check trials. The first check trial occurred after the pretraining. The objective was to learn whether the child would relocate the object if it was marked. The experimenter hid the target and then placed a different colored lid on the container. The child predicted whether he or she would relocate the object. The second and third check trials occurred after the eight test trials. The objective of these trials was to assess whether the child realized that the object could not be retrieved reliably if the searcher had not seen where it was stored.

The experimenter stored the target while the child was not looking, and then asked the prediction question. The correct response was to say that he or she would not be able to find the object. On the third check trial the child hid the sticker behind his or her back, and predicted whether the experimenter would find the object when she guessed which hand held it. (Pilot testing had established that children of this age would move the object to the non-chosen hand to foil the experimenter's guess.) The correct response was to predict that the experimenter would not find the object.

Marking strategy trial. At the end of the session, the experimenter introduced a marker and recorded the number of prompts required before the child used it (Ritter, 1978). After the target was hidden as usual, the child was given the grease pencil. The experimenter asked the child if he or she could use the pencil to help relocate the sticker (Prompt 1). If the child did not mark the baited container she pointed to it and asked "can you use the pencil over here to help you find the sticker right away?" (Prompt 2). If the child still did not mark the container, the experimenter marked an unbaited container and asked the child if he or she wanted to "put a mark on some other place to help you find the sticker right away" (Prompt 3). If necessary, the experimenter then marked the baited container (Prompt 4). She then asked the child if he or she wanted to mark any other containers or to erase any of the marks. The distractor and relocation tasks then followed. The experimenter recorded the number of prompts provided to the child on this trial.

Results

Test trials. Correct predictions consisted of trials on which the child said he or she would not remember and then did not relocate the object, plus trials on which the child said he or she would remember and then did successfully relocate the object. The number of correct predictions was summed for each child. Scores for the older group were significantly higher (M = 5.90 on eight trials) than for the preschoolers (M = 3.43), suggesting that the second graders were more accurate in predicting their own

performance, $t(22) = 4.41$, $p < .01$. Similarly, when only the *overestimates* of performance were considered (i.e., trials on which the child said he or she would relocate the object but then did not actually do so), older children were less likely to overestimate their performance ($M = 2.00$) while younger children overestimated their ability on slightly more than half of the eight trials ($M = 4.43$). Table 1 shows the mean scores for older and younger children for the possible response patterns (overestimation, underestimation, and accurate estimation of performance). In addition, older children were more accurate on the second half of trials while younger children's estimates did not improve across trials.

Table 1 about here

All of the older children and many (57%) of the younger children spontaneously used strategies to prepare for retrieval. However, the older children were more likely (90%) to use the effective strategy of counting the rows and columns on the board, while the younger children (100%) were more likely to stare at the container, touch it, or mention a potential landmark on the board. Six of the younger children also attempted to use the counting strategy at least once during the test trials, but did so ineffectively (usually by counting only rows but not columns.) Older children were significantly more likely to use an effective strategy than younger children, $X^2(1) = 5.53$, $p < .05$.

Marking strategy trial. After the test trials, children were given the pencil and prompted to use it to mark the baited container. Older children were more likely (90%) to spontaneously mark the container when given the pencil, while younger children were more likely (50%) to require one or more prompts, $X^2(1) = 4.20$, $p < .05$. After the container had been marked by either the child or the experimenter, the child was given the chance to add other marks and to erase the target mark. Both older (100%) and younger (86%) children chose to retain the target mark. Half of the younger children

added additional marks, as did 30% of the older children, but all were careful to retain the distinctiveness of the target mark by marking new containers that were far away from the baited one, or by making the target mark darker than the other marks. (One five year old carefully marked all the containers in a circle surrounding the baited container.)

Discussion

The results from this study were generally consistent with previous research in showing that preschoolers tended to overestimate their own memory prowess; in this case, children overestimated their ability to remember exactly where a target object had been stored in a very large set of possible locations (Heisel & Ritter, 1981). In addition, the younger children were less likely to use effective strategies to prepare for retrieval, and they required more prompts to use a marker to help themselves relocate the hidden object (Ritter, 1978).

Previous research on children's knowledge about their own memory limitations had generally suggested that older children were more accurate in their assessments of their own memory, while younger children tended to overestimate how well they would remember. This overconfidence was assumed to contribute to preschoolers' failure to use strategies to enhance their ability to remember new information and to their resistance to acquiring effective strategies. However, there had been relatively little discussion about why younger children might overestimate their own mental abilities. The results of this study provide some preliminary views on the source of this overconfidence: Young children may be overconfident in the efficacy of their own strategies, not in their ability to remember without assistance. That is, preschoolers may not simply assume that they will automatically remember new information without taking some action or making some effort to remember. Rather, the observations from this study suggest that in some cases they may be taking actions that they believe will enhance their memory. The catch is that young children may not know exactly what

actions to take, or how to select and execute an effective strategy for a particular memory task.

The claim that the preschooler's behaviors in this study (and in the pilot study described earlier) were actually strategic is supported by the fact that many resembled partial fragments or components of more effective strategies. For example, the strategy of looking at or touching the target object might reflect the understanding that the target object must be clearly distinguished from the other objects; the child may be rehearsing or reassuring him or herself that "this is the one I need to find." The looking-touching strategy has even been observed in some two year olds (Wellman, Ritter & Flavell, 1975). Other children attempted to use visual landmarks as reference points, which would have been effective for many everyday memory tasks (Acredolo, Pick & Olsen, 1975). Some preschool children attempted to use the counting strategy, but did so only partially. Similarly, in the pilot study using the Ritter (1978) task some children seemed to recognize that they should create an association between the marker and target at either storage or retrieval. In other cases, children suggested retrieval strategies that would have been effective in everyday search tasks, such as shaking the containers. Development in this area may therefore consist of building effective memory strategies out of such strategy fragments, and in learning to match the appropriate strategy to particular memory tasks.

A key issue for future research is why young children do not adopt effective strategies more easily than they apparently do, and whether they tend to retain ineffective strategies in place of those that are offered by adults. One possibility is that young children may not be able to pinpoint exactly how their own actions deviate from a more effective version of the strategy (e.g., the need to count columns in addition to rows.) Another possibility is that young children's activities may well have worked in the past and might at least increase the chances of occasional success on the new and

unfamiliar task (although not by much.) Finally, motivational issues may also be a factor, including personal investment in a strategy, a lingering sense of uncertainty about how to execute a new strategy, and feelings of self-efficacy when a self-generated strategy does succeed (Schneider,1988).

The results of this study confirmed earlier findings that preschoolers overestimated their performance in a memory task, and that they failed to use effective strategies to improve their performance. However, more detailed observations of the younger children suggested first, that they attempted to use memory strategies, and second, that preschoolers may be overconfident of their ability to remember because they overestimate the efficacy of their strategies, rather than their own memory prowess.

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Table 1: Mean number of trials on which children overestimated, underestimated, and accurately predicted their relocation performance

		Response Patterns:			
	Predict:	Yes	Yes	No	No
	Relocate:	Yes	No	Yes	No
Age:		(accurate)	(overest.)	(underest.)	(accurate)
5 years		1.93	4.43	0.14	1.50
7 years		4.70	2.00	0.10	1.20